

INDELIBLE WATERMARK ON OPTICAL DISCS

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This application claims the benefit of
provisional patent application No. 60/258,462, filed on
5 December 27, 2000, which is hereby incorporated by
reference in its entirety.

Background of the Invention

This invention relates to information-
recording media in the form of light-readable disks,
10 and more particularly to providing indelible marking on
such information-recording media for identification and
verification of authenticity.

Light-readable information-bearing disks are
well known, as disclosed in Kramer U.S. patent No.
15 5,068,846, Mecca U.S. patent No. 5,995,481, and
Marquardt U.S. patent No. 5,729,533. Commercially
available digital video discs ("DVDs"), compact discs
("CDs"), and compact disc read-only memories ("CD-
ROMs") exemplify recording media of this general type.

20 Light-readable information-bearing disks
typically comprise a transparent plastic disk-shaped
substrate, one surface of which comprises sequences of
depressions ("pits") and intermediate areas ("lands").
These pits and lands are arranged in accordance with
25 the information intended to be read by means of optical
radiation. The patterned side of the plastic substrate

may be covered with a reflective coating, conforming to the local changes in the surface. Light (typically laser light) directed toward the pattern is reflected differently depending on whether the light strikes a high or a low spot. In this way, the light reads the information recorded by the pattern of pits and lands. This information can be processed and played back.

The manufacturing of optical disks is also well known in the art. Conventionally, the process begins with cleaning and polishing one surface of a glass plate. The surface is then covered with a uniform thin layer of photoresistive material. After the photoresistive material is cured, a pattern representing digital data is recorded in the photoresistive layer using a modulated high-energy laser beam. The pattern is subsequently developed and the extra material is removed, leaving a photoresistive coating on the surface of the glass, which comprises a pattern of pits and lands representing the digital data.

Next, the photoresistive coating on the glass plate is covered with a nickel layer, thus creating a "master." The master is electroplated with nickel to provide a mating form, referred to as a "father." The father is also plated with nickel to build a negative image in the form of the original master, referred to as a "mother." The mother disk is then used to form "production stampers" for molding the optical disks.

Sub A1 One process of injection molding of optical disks is described in application No. 09/751,646 (Pickutoski et al.), which is hereby incorporated by reference. According to the method described in this application, polycarbonate plastic material is injection molded against a production stamper and, when

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removed from the injection molding machine, has the shape of a substrate having on one surface pits and lands in the pattern representing the digital data.

With the widespread use of light-readable information-bearing disks, disc manufacturers have been increasingly concerned about counterfeit discs. To address this concern, various complicated security systems have been developed. (E.g., Warren et al. U.S. patent No. 5,719,937 and EP 0 671 730 A1).

In the past, marks have been applied to light-readable information-bearing discs through the use of production stampers having the topological features representing graphical or other images on the same side of the stampers as the pits and lands representing digital data. (Kodaka et al. U.S. patent No. 5,346,654, Abraham U.S. patent No. 5,452,282, Bahns U.S. patent No. 5,946,286, and Shin et al. U.S. patent No. 5,398,231). The prior art methods are complicated, time-consuming, and require the use of expensive equipment, such as laser beam recorders. Accordingly, it is desirable to provide simple cost-effective solutions for marking discs, so that authentic discs would be readily distinguishable from counterfeit discs.

In view of the foregoing, it is an object of this invention to provide indelible marks on information-recording media for identification and verification of authenticity of such media.

Summary of the Invention

These and other objects are accomplished in accordance with the principles of the invention by providing methods for manufacturing light-readable information-recording media, wherein the back of a

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FIG. 1 shows a simplified partial cross-sectional view of a typical injection mold, which includes a cavity 30, a top plate 40, a stamper 10, and

a bottom plate 50. In accordance with the principles of the present invention, the back of the metal stamper 10 is marked (preferably laser-scribed, but also may be diamond-scribed, etched, applied using a mechanical tool, etc.) before sanding. Alternatively, the mark can be deposited on the stamper after the stamper has been sanded.

Sub A2

As shown in FIG. 1, the illustrative stamper 10 made in accordance with this invention bears markings 20 (enlarged for illustrative purposes) corresponding to a desired watermark image. The image may comprise any indicia, for example, pictures or graphical images, trademarks, symbols, words, numbers, or any combination thereof.

A moldable material, such as a polycarbonate-based thermoplastic, is liquified by heating to a temperature sufficient to permit uniform flow into the mold cavity. Molten material 60 is then injected into the cavity 30 at high pressure, causing the molten material 60 to conform to the contours of the stamper 10, thereby producing a substrate comprising pits and lands. In accordance with the principles of the present invention, during the process of molding, markings 20 on the back of the stamper 10 are transferred, as a watermark, to the information-carrying side of the optical disc substrate. FIG. 2 shows an illustrative optical disc 35 according to the present invention, bearing a watermark image 25, corresponding to the markings 20 on the metal stamper 10, that is visible under normal light conditions.

It will be understood that FIG. 1 is only illustrative of the principles of the present invention and that various modifications can be made by those skilled in the art without departing from the scope and

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spirit of the invention. For example, the present invention is also suitable for use in systems using injection-compression molding or compression molding.

Dimensions of the mark, which is laser-scribed, etched, or deposited on a stamper, are chosen so that the mark is effectively transferred to and is visible on the resulting light-readable information-carrying media without disrupting the play-back of information recorded by means of pits and lands.

Those of ordinary skill in the art may vary the dimensions of markings on the back of a production stamper depending on system parameters, such as the material and thickness of the stamper, the pressure in the mold cavity, and the desired dimensions of the resulting watermark. If the mark is applied to the production stamper using a laser-scriber, the dimensions of the mark can be varied by changing the power of the laser.

The watermark image may be placed anywhere on the optical disc. For example, the watermark may either be superimposed onto the digital data recorded by means of pits and lands or be formed on the periphery of the data-containing region. In the first case, the watermark will not affect playability, if the surface variations due to the presence of the watermark do not exceed the depth of focus of the system used to read the data. On the other hand, if the mark is large enough to cause disruption of play-back, the lost data can be reconstructed by error-correction. When the watermark is formed on the periphery of the information-containing region, the constraints on the dimensions of the watermark are less strict. In this case, however, the area available for the placement of the watermark is smaller.

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The transferred watermark image on disc replicas is visible under normal light conditions, so that authentic discs can be readily distinguished from counterfeit discs. Such watermarks may be designed to
5 be machine-readable. Also, because the image is molded into the optical media, it is irreversible and permanent. Further, since only the back of the metal stamper needs to be marked for the image to be reproduced in all discs manufactured using this
10 stamper, the solution in accordance with the principles of this invention provides a cost-effective way of marking a number of discs.

One skilled in the art will appreciate that this invention can be practiced using other than the
15 described embodiments, which are presented for purposes of illustration and not of limitation. This invention is therefore limited only by the claims which follow.

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